

WHAT IS CLAIMED IS:

1. A method for making a diffraction grating device having a diffraction grating formed by refractive index modulation over a predetermined area  
5 in an optical waveguide along a longitudinal direction thereof;

the method comprising the steps of:

disposing a phase grating mask beside the optical waveguide;

10 irradiating the optical waveguide with refractive index change inducing light by way of the phase grating mask while repeatedly scanning an irradiation point of the refractive index change inducing light in the longitudinal direction;

15 vibrating the phase grating mask in the longitudinal direction relative to the optical waveguide upon irradiation with the refractive index change inducing light; and

changing a phase or period of vibration of the  
20 phase grating mask for each scan of the irradiation point of the refractive index change inducing light,

so as to form a diffraction grating in the optical waveguide.

2. A method according to claim 1, wherein the  
25 irradiation position of the refractive index change inducing light is scanned N times, where N is an

integer of 2 or greater, while the phase of vibration of the phase grating mask is shifted by  $2\pi/N$  for each scan.

5           3.     A method according to claim 2, wherein N is a power of 2.

          4.     A method for making a diffraction grating device having a diffraction grating formed by refractive index modulation over a predetermined area in an optical waveguide along a longitudinal direction thereof;

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          the method comprising the steps of:

          disposing a phase grating mask beside the optical waveguide;

          irradiating the optical waveguide with refractive index change inducing light by way of the phase grating mask while scanning an irradiation point of the refractive index change inducing light in the longitudinal direction;

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          vibrating the phase grating mask in the longitudinal direction relative to the optical waveguide upon irradiation with the refractive index change inducing light; and

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          changing a phase or period of vibration of the phase grating mask upon scanning the irradiation point of the refractive index change inducing light,

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          so as to form a diffraction grating in the

optical waveguide.

5. An apparatus for making a diffraction grating device having a diffraction grating formed by refractive index modulation over a predetermined area in an optical waveguide along a longitudinal direction thereof;

the apparatus comprising:

refractive index change inducing light irradiating means for irradiating the optical waveguide with refractive index change inducing light by way of a phase grating mask disposed beside the optical waveguide, and repeatedly scanning an irradiation position of the refractive index change inducing light in the longitudinal direction; and

phase grating mask vibrating means for vibrating the phase grating mask in the longitudinal direction relative to the optical waveguide upon irradiation with the refractive index change inducing light, and changing a phase or period of vibration of the phase grating mask for each scan of the irradiation point of the refractive index change inducing light.

6. An apparatus according to claim 5, wherein the refractive index change inducing light irradiating means scans the irradiation position of the refractive index change inducing light N times, where N is an integer of 2 or greater; and

wherein the phase grating mask vibrating means shifts the phase of vibration of the phase grating mask by  $2\pi/N$  for each scan.

5        7.     An apparatus according to claim 6, wherein  
N is a power of 2.

10       8.     An apparatus for making a diffraction  
grating device having a diffraction grating formed by  
refractive index modulation over a predetermined area  
in an optical waveguide along a longitudinal direction  
thereof;

the apparatus comprising:

15       refractive index change inducing light  
irradiating means for irradiating the optical waveguide  
with refractive index change inducing light by way of a  
phase grating mask disposed beside the optical  
waveguide, and scanning an irradiation position of the  
refractive index change inducing light in the  
longitudinal direction; and

20       phase grating mask vibrating means for vibrating  
the phase grating mask in the longitudinal direction  
relative to the optical waveguide upon irradiation with  
the refractive index change inducing light, and  
changing a phase or period of vibration of the phase  
grating mask upon scanning the irradiation point of the  
25       refractive index change inducing light.

9.     A diffraction grating device made by the

method according to claim 1.

10. A multi/demultiplexing module including the diffraction grating device according to claim 9, the diffraction grating device selectively reflecting a  
5 light component having a reflection wavelength, so as to multiplex or demultiplex light.

11. An optical transmission system for carrying out optical transmission by using wavelength-multiplexed signal light having a plurality of  
10 wavelengths, the optical transmission system including the multi/demultiplexing module according to claim 10, the multi/demultiplexing module multiplexing or demultiplexing the signal light having a plurality of wavelengths.

15 12. A diffraction grating device made by the method according to claim 4.

13. A multi/demultiplexing module including the diffraction grating device according to claim 12, the diffraction grating device selectively reflecting a  
20 light component having a reflection wavelength, so as to multiplex or demultiplex light.

14. An optical transmission system for carrying out optical transmission by using wavelength-multiplexed signal light having a plurality of  
25 wavelengths, the optical transmission system including the multi/demultiplexing module according to claim 13,

the multi/demultiplexing module multiplexing or demultiplexing the signal light having a plurality of wavelengths.